REMARKS

Claim 1 has been amended. Previously withdrawn claims 13-24 are canceled. Claims 1-12 remain pending in this application, with claim 1 being the only independent claim. Claims 1-12 have been rejected under 35 U.S.C. §103(a) as unpatentable over European Patent EP 1 249 869 to Mattmann et al. ("Mattmann") in view U.S. Patent No. 4,521,476 ("Asai"), and U.S. Patent No. 3,714,709 to Liederbach ("Liederbach"), and further in view of U.S. Patent No. 5,245,510 ("Honda").

Rejection of claims 1-12 under 35 U.S.C. §103(a)

The Office Action states that the combination of Mattmann, Asai, Liederbach, and Honda teaches all of Applicants' recited elements.

Independent claim 1 has been amended to recite an electronics unit that includes a low multi-point metallic mount (1) that includes a material having a melting point below 600 degrees Celsius, an insulating layer that includes a sintered electrically insulating polymer layer (3) arranged on the mount (1), and a conductor track system (4, 5, 6) that includes a sintered glass frit with a noble metal filling arranged on the insulating layer, where the sintered glass frit has a melting point that is lower than the melting point of the metallic mount, so that the glass frit is sinterable onto said mount. The electronics unit further includes a resistance layer (7) printed onto the polymer layer (3) within one area of the conductor track (6), and electronic power components (8, 10) arranged on the conductor track system (4, 5, 6). Support for the claim amendment can be found in paragraphs [0012] and [0013] of the published specification.

The combination of Mattmann, Asai, Liederbach, and Honda fails to teach or suggest, "an insulating layer comprising a sintered electrically insulating polymer layer arranged on said

mount", and "the sintered glass frit has a melting point that is lower than the melting point of the metallic mount, so that the glass frit is sinterable onto said mount", as recited in Applicants' amended independent claim 1.

Mattmann discloses a cooling device that includes an aluminum carrier (1) to which an insulating layer (2) made of ceramic material is applied. Mattmann also discloses that a power semiconductor device (3) is arranged on the insulating layer (2), and that the power semiconductor device (3) may be arranged on a conduction layer (5) on the insulating layer (2). Further, Mattmann discloses that film resistors made of polymer paste maybe be arranged on the insulating layer (2).

The Examiner concedes that Mattmann fails to teach or suggest an insulating layer comprising a sintered electrically insulating polymer layer, and that the conductor track system is comprised of a sintered glass frit with a noble metal filling. Mattmann, also fails to teach or suggest "the sintered glass frit has a melting point that is lower than the melting point of the metallic mount, so that the glass frit is sinterable onto said mount", as recited in Applicants' amended independent claim 1.

The Examiner cites Fig. 5 and col. 2, line 60 to col. 3, line 4 of Asai as teaching an insulating layer comprising a sintered electrically insulating polymer layer. The Examiner also states that it is well known in the art that epoxies are cured by the application of heat.

Asai discloses a hybrid integrated circuit. The hybrid integrated circuit of Asai is produced by laminating an aluminum-copper clad foil on an insulating layer, and etching the aluminum-copper clad foil with etching agents to form an aluminum circuit and a copper circuit. Asai further discloses that a semiconductor element is then connected to the aluminum circuit through an aluminum wire or a gold wire, and a circuit element is connected to the copper circuit.

The cited passages of Asai read: "The insulating layer 1 used in the present invention may be of an organic polymer such as epoxy resin, phenol resin, silicon resin, polyimide resin etc., an inorganic material or a composite material composed of an inorganic material and an organic polymer such as glass-epoxy. It is particularly desirable to use a composite material composed of an organic polymer and an inorganic powder having an excellent heat conductivity such as beryllia, boron nitride, alumina, magnesia, silica etc. which is incorporated at an amount greater than the organic polymer, because it has a high heat conductivity and inhibits to occur a phenomenon of the escaping of a ultrasonic wave."

However, col. 4, lines 50-60 of Asai read: "An aluminum-copper clad foil (9) same as in FIG. 1 was prepared. The surface of the copper foil was coated with inorganic powder filled epoxy resin (RAMDITE manufactured by Denki Kagaku Kogyo Kabushiki Kaisha) at a thickness of 100 μm. On the coated layer, an aluminum plate (8) having a thickness of 2 mm was laminated and was cured at a room temperature under a pressure to obtain a supporting substrate having an insulating layer 1."

It is known to one skilled in the art that a sintering process is carried out by heating a material (see attached Wikipedia entry for sintering). However, as indicated above, Asai teaches that a copper foil is coated with inorganic powder filled epoxy resin. On the coated layer of Asai, an aluminum plate is laminated and cured at *room temperature* under pressure to obtain a supporting substrate having an insulating layer. Therefore, Asai fails to teach or suggest "an insulating layer comprising a sintered electrically insulating polymer layer arranged on said mount, so that the glass frit is sinterable onto said mount", as recited in Applicants' amended claim 1. Further, Asai fails to teach or suggest a glass frit and, therefore, fails to teach or suggest, "the sintered glass frit has a melting point that is lower than the melting point of the

metallic mount, so that the glass frit is sinterable onto said mount", as recited in Applicants' amended independent claim 1.

The Examiner cites col. 3, lines 8-31 of Liederbach as teaching an electronic system which has a conductor track system comprising a sintered glass frit with a noble metal filling.

Liederbach discloses a method of manufacturing thick-film hybrid integrated circuits. The method of Liederbach includes screen printing a pattern of conductors, resistors, capacitors, and inductors on a ceramic substrate, curing the components, covering the cured components and substrate with a thin layer of a resin composition while leaving openings in the layer for mounting discrete components and jumpers, mounting the discrete components, and encapsulating the resulting device in a resin composition.

The cited passages of Liederbach, while teaching a glass frit, more specifically teach a borosilicate frit (see col. 3, line 24 of Liederbach). It is well known to those skilled in the art that borosilicate glass has a melting point (approximately 821 degrees Celsius), which is much higher than ordinary silicate glass (see attached Wikipedia entry for Borosilicate glass under "Manufacturing Process" and "Composition and physical characteristics").

Applicants' amended claim 1 recites "an electronics unit, comprising: a low multi-point metallic mount <u>comprising a material having a melting point below 600 degrees Celsius</u>", and a conductor track system comprising a sintered glass frit with a noble metal filling arranged on said insulating layer<u>, the sintered glass frit having a melting point that is lower than the melting point of the metallic mount, so that the glass frit is sinterable onto said mount</u>". Thus, Applicants' glass frit has a melting point lower than 600 degrees Celsius, unlike the glass frit of Liederbach.

Therefore, Liederbach fails to teach or suggest, "the sintered glass frit has a melting point that is lower than the melting point of the metallic mount", as recited in Applicants' amended independent claim 1. Liederbach also fails to teach or suggest, "an insulating layer comprising a sintered electrically insulating polymer layer arranged on said mount, so that the glass frit is sinterable onto said mount", as recited in Applicants' amended independent claim 1.

Honda is directed to hybrid integrated circuit device that has a primary heat sink, a secondary heat sink, and a heat-generating semiconductor chip mounted on the primary heat sink. A thermocouple is embedded in a portion of the primary heat sink immediately below a heat-generating portion of the semiconductor chip of Honda. Power supplied to the semiconductor chip of Honda is controlled in accordance with the measured temperature of the heat-generating portion of the semiconductor chip, thus enabling the semiconductor chip to operate at its full output performance without risk of breakdown due to overheating.

Honda clearly fails to teach or suggest, "an insulating layer comprising a sintered electrically insulating polymer layer arranged on said mount" and "the sintered glass frit has a melting point that is lower than the melting point of the metallic mount, so that the glass frit is sinterable onto said mount", as recited in Applicants' amended independent claim 1.

In view of the foregoing, Mattmann, Asai, Liederbach, and Honda, whether taken alone or in combination, fail to teach or suggest the subject matter recited in Applicants' amended independent claim 1. Accordingly, claim 1 is patentable over Mattmann, Asai, Liederbach, and Honda under 35 U.S.C. §103(a).

Claims 2-12, which depend directly or indirectly from amended independent claim 1, incorporate all of the limitations of independent claim 1 and are therefore deemed to be

patentably distinct over Mattmann, Asai, Liederbach, and Honda for at least those reasons discussed above with respect to amended independent claim 1.

Conclusion

In view of the foregoing, reconsideration and withdrawal of all rejections, and allowance of all pending claims is respectfully solicited.

Should the Examiner have any comments, questions, suggestions, or objections, the Examiner is respectfully requested to telephone the undersigned in order to facilitate reaching a resolution of any outstanding issues.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,

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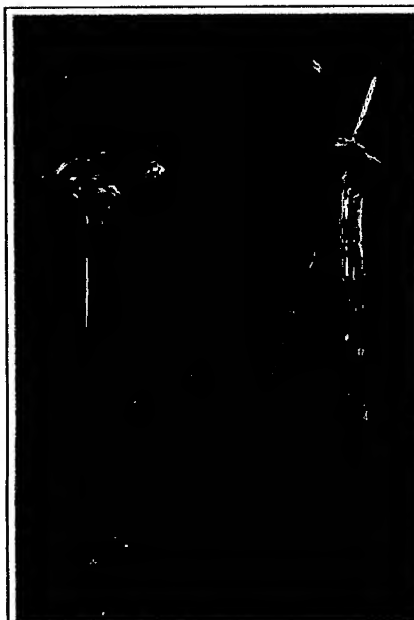
Borosilicate glass

From Wikipedia, the free encyclopedia



Schott Duran glassware, here displayed two beakers and a test tube.

Borosilicate glass is a type of heat-resistant glass. Borosilicate glass was first developed by German glassmaker Otto Schott in the late 19th century and sold under the brand name "Duran" in 1893. After Corning Glass Works introduced Pyrex in 1915, it became a synonym for borosilicate glass in the English-speaking world. Holophane manufactures original equipment lenses for street lights under the Endural brand name. Bomex is a brand of borosilicate glassware made in China for a number of resellers in the United States and abroad.

Most borosilicate glass is clear. Colored borosilicate, for the art glass trade, was first widely brought onto the market in 1986 when Paul Trautman founded Northstar Glassworks. There are now a number of small companies in the U.S. and abroad that manufacture and sell colored borosilicate glass for the art glass market.

In addition to the quartz, sodium carbonate, and calcium carbonate traditionally used in glassmaking, boron is used in the manufacture of borosilicate glass. Typically, the resulting glass composition is about 70% silica, 10% boric oxide, 8% sodium oxide, 8% potassium oxide, and 1% calcium oxide (lime). Though somewhat more difficult to make than traditional glass (Corning conducted a major revamp of their operations to make it), it is economical to produce because its superior durability, chemical and heat resistance finds excellent use in chemical laboratory equipment, cookware, lighting, and in certain cases, windows.

Contents

Manufacturing process

Borosilicate glass is created by adding boron to the traditional glassmaker's "frit" of silicate sand, soda, and ground lime. Since borosilicate glass melts at a higher temperature than ordinary silicate glass, some new techniques were required to bring it into industrial production. Borrowing from the welding trade, new burners combining oxygen with natural gas were required.

Composition and physical characteristics

Borosilicate glass has a very low thermal expansion coefficient, about one-third that of ordinary glass. This reduces material stresses caused by temperature gradients, thus making it more resistant to breaking. This makes it a popular material for objects like telescope mirrors, where it is essential to have very little deviation in shape. It is also used in the processing of high-level nuclear waste, where the waste is immobilised in the glass through a process known as vitrification (contrast with Synroc).

Borosilicate glass begins to soften around 821 °C (1510 °F); at this temperature, the viscosity of type 7740 Pyrex is $10^{7.6}$ poise. [1]

Borosilicate glass is less dense than ordinary glass.

While more resistant to thermal shock than other types of glass, borosilicate glass can still crack or shatter when subject to rapid or uneven temperature variations. When broken, borosilicate glass tends to crack into large pieces rather than shattering (it will snap rather than splinter).

Optically, borosilicate glasses are crown glasses with low dispersion (Abbe numbers around 65) and relatively low refractive indices (1.51–1.54 across the visible range).

Fraction by weight

Element	Atomic number	Fraction
B	5	0.040064
O	8	0.539562
Na	11	0.028191
Al	13	0.011644
Si	14	0.377220
K	19	0.003321

Physical characteristics
Density = 2.23 g/cm³
Mean Excitation Energy = 134.0 eV

Usage

Borosilicate glass's refractory properties and physical strength make it ideal for use in laboratories, where it is used to make high-durability glass lab equipment, such as beakers and test tubes. In addition, borosilicate glass warps minimally when exposed to heat allowing a borosilicate container to provide accurate measurements of volume over time.

During the mid-twentieth century borosilicate glass tubing was used to pipe coolants (often distilled water) through high power vacuum tube–based electronic equipment, such as commercial broadcast transmitters.

Glass cookware is another common usage; a borosilicate glass pie plate is almost the American standard pie dish. Borosilicate glass measuring cups, which featured painted-on markings illustrating graduated

measurements, are also widely used in American kitchens.

Aquarium heaters are sometimes made out of borosilicate glass. Due to its high heat resistance, it can tolerate the great temperature differences between water and the nichrome heating element.

Many high quality flashlights, such as those made by Surefire, use borosilicate glass for the lens. This allows for a higher percentage of light transmittance through the lens than compared to plastics and lower-quality glass.

Specialty marijuana pipes (commonly sold as tobacco pipes for reasons of legality) are made from borosilicate glass. The high heat resistance allows the pipe to tolerate a longer period of use, and these pipes are also more durable.

Most premanufactured glass guitar slides are also made of borosilicate glass.

New lampworking techniques led to artistic applications such as contemporary glass marbles. The modern glass art movement, spurred largely by the rapid development of a borosilicate color palette at Northstar Glass in the 1980s and 1990s, has provided vast economic growth for borosilicate glass suppliers. Borosilicate is commonly used in the glassblowing form of lampworking and the artists create a range of products ranging from jewelry, kitchenware, to sculpture as well as for the previously mentioned artistic glass "tobacco" pipes.

Borosilicate glass is sometimes used for high-quality beverage glassware; Bodum, Inc. markets a line of French coffee presses and double-walled beverage glasses made of borosilicate, lending them increased durability and microwave/dishwasher compatibility.

Most astronomical reflecting telescope glass mirror components are made of borosilicate glass due to the low coefficient of expansion due to heat. This makes very precise optical surfaces possible that change very little with temperature, and matched glass mirror components that "track" across temperature changes and retain the optical system's characteristics. Borosilicate glass is not used for high quality lenses due to striations and inclusions common to this type of glass.

Borosilicate is also a material of choice for evacuated tube solar thermal technology, due to its high strength and heat resistance.

Borosilicate glasses also find application in the semiconductor industry in the development of micromechanical devices, known as MEMS, as part of stacks of etched silica wafers bonded to the etched borosilicate glass.

References

1. ^ Melting Point Table (http://www.cowtown.net/mikefirth/techspec.htm). Retrieved on 2006-10-22.

External links

- Properties of SCHOTT DURAN® Borosilicate Glass - Overview (http://www.duran-group.com/english/products/duran/properties/index.html)

- [1] (http://www.corning.com/docs/specialtymaterials/pisheets/WaferSht.pdf)

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Categories: Glass | Boron compounds

Sintering

From Wikipedia, the free encyclopedia
(Redirected from Sinter)

Sintering is a method for making objects from powder, by heating the material (below its melting point) until its particles adhere to each other. Sintering is traditionally used for manufacturing ceramic objects, and has also found uses in such fields as powder metallurgy.

The word "sinter" comes from the Middle High German *Sinter*, a cognate of English "cinder".

Sintered bronze in particular is frequently used as a material for bearings, since its porosity allows lubricants to flow through it or remain captured within it. In the case of materials with high melting points such as Teflon and tungsten, sintering is used when there is no alternative manufacturing technique. In these cases very low porosity is desirable and can often be achieved.

Sintered Bronze and Stainless steel are used as filter materials in applications requiring high temperature resistance while retaining the ability to regenerate the filter element. For example, sintered stainless steel elements are used for filtering steam in food and pharmaceutical applications.

In most cases the density of a collection of grains increases as material flows into voids, causing a decrease in overall volume. Mass movements that occur during sintering consist of the reduction of total porosity by repacking, followed by material transport due to evaporation and condensation from diffusion. In the final stages, metal atoms move along crystal boundaries to the walls of internal pores, redistributing mass from the internal bulk of the object and smoothing pore walls. Surface tension is the driving force for this movement.

Metallurgists can sinter most, if not all, metals. This applies especially to pure metals produced in vacuum which suffer no surface contamination. Many nonmetallic substances also sinter, such as glass, alumina, zirconia, silica, magnesia, lime, ice,beryllium oxide, ferric oxide, and various organic polymers. Sintering, with subsequent reworking, can produce a great range of material properties. Changes in density, alloying, or heat treatments can alter the physical characteristics of various products. For instance, the tensile strength E_n of sintered iron powders remains insensitive to sintering time, alloying, or particle size in the original powder, but depends upon the density (D) of the final product according to $E_n/E = (D/d)^{3.4}$, where E is Young's modulus and d is the maximum density of iron.

Particular advantages of this powder technology include:

1. the possibility of very high purity for the starting materials and their great uniformity
2. preservation of purity due to the restricted nature of subsequent fabrication steps
3. stabilization of the details of repetitive operations by control of grain size in the input stages
4. absence of stringering of segregated particles and inclusions (as often occurs in melt processes)
5. no requirement for deformation to produce directional elongation of grains

Many literary references exist on sintering dissimilar materials for solid/solid phase compounds or solid/melt mixtures in the processing stage. Any substance which melts may also become atomized using a variety of powder production techniques. When working with pure elements, one can recycle scrap remaining at the end of parts manufacturing through the powdering process for reuse.

Contents

Ceramic sintering

Sintering is part of the firing process used in the manufacture of pottery and other ceramic objects. Some ceramic raw materials have a lower affinity for water and a lower plasticity index than clay, requiring organic additives in the stages before sintering. The general procedure of creating ceramic objects via sintering of powders includes:

- Mixing water, binder, deflocculant, and unfired ceramic powder to form a slurry
- Spray-drying the slurry
- Putting the spray dried powder into a mold and pressing it to form a *green body* (an unsintered ceramic item)
- Heating the green body at low temperature to burn off the binder
- Sintering at a high temperature to fuse the ceramic particles together

All the characteristic temperatures associated to phases transformation, glass transitions and melting points, occurring during a sinterisation cycle of a particular ceramics formulation (i.e. tails and frits) can be easily obtained by observing the expansion-temperature curves during optical dilatometer thermal analysis. In fact, sinterisation is associated to a remarkable shrinkage of the material due to the fact that glass phases flow, once their transition temperature is reached, and start consolidating the powdery structure and considerably reducing the porosity of the material.

There are two types of sintering: with pressure (also known as hot pressing), and without pressure. Pressureless sintering is possible with graded metal-ceramic composites, with a nanoparticle sintering aid and bulk molding technology. A variant used for 3D shapes is called hot isostatic pressing.

See also

- Selective laser sintering, a rapid prototyping technology.

External Links

- Particle-Particle-Sintering - a 3D lattice kinetic Monte Carlo simulation (http://www.roentzsch.org/SintPP/index.html)
- Sphere-Plate-Sintering - a 3D lattice kinetic Monte Carlo simulation (http://www.roentzsch.org/SintSP/index.html)

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Chiang, Yet-Ming; Birnie, Dunbar P. & Kingery, W. David (May 1996), *Physical Ceramics: Principles for Ceramic Science and Engineering*, John Wiley & Sons, ISBN 0-4715-9873-9

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